

Perhaps the constant-controversy is not quite so obviously settled as some English physicists seem to think. But, however the future may regard it, history will record that on January 6 of this year died one of the greatest mathematical physicists and undoubtedly the greatest elastician that Europe has seen since the age of Poisson and Cauchy. KARL PEARSON

ON SOME INTERESTING CASES OF MIGRATIONS OF MARINE FISHES, ON THE COAST OF VENEZUELA AT CARÚPANO

CARÚPANO is a thriving seaport on the northern coast of Venezuela, midway between the peninsulas of Araya and Paria, in lat. $10^{\circ} 14' 15''$ N., and long. $63^{\circ} 18'$ W. from Greenwich, and therefore in close vicinity to the channel which leads from the Atlantic into the Caribbean Sea between Tobago and Grenada on the one side, and Trinidad and the South American mainland on the other side. Through this channel enters the great western current of the Caribbean Sea, running at the rate of about one mile and a half an hour, though not with much regularity. The coast-line forms the western prolongation of the northern shore of Trinidad, trending almost due west. The water is rather shallow to a considerable distance from the land, the 100-fathom line due north of Carúpano being about 60 miles off the shore,¹ which gives for the sea-bottom a gradient of but 1·67 per 1000.²

Such are, in a few words, the general hydrographic conditions of that locality, famous in this country for the frequent occurrence of immense shoals of fish of different kinds, which, either alive or dead, are finally thrown by the surf on the beach. The inhabitants call the shoals *ribazones* when the fish arrive alive; in the other case they are called *turbios*, on account of the turbid appearance the sea presents in such circumstances.

Though the *ribazones* may occur at any time of the year, it appears that there is a greater probability of their advent during the rainy season, or from May to November. The weather must be fine, with a moderate breeze from the sea. The shoals are composed of a great many different species; most of the fish are, however, of small size. They are followed by large numbers of predatory denizens of the deep, sharks being generally prominent amongst them. In some cases the presence of whales has been recorded; it is undoubtedly the cachalot (*Cetodon macrocephalus*), which occasionally visits the Caribbean Sea.³ At the same time large flights of sea-gulls accompany the shoal, picking up a considerable number of fish, and, with their deafening shrieks and endless whirls, adding to the picturesque vividness of the scene. Owing to these manifold persecutions the frightened fish make towards the shallow water of the shore in such haste and with such impetuosity that the sea is almost boiling with foam for many miles. Most of the fish are still alive when they reach the beach, where the inhabitants, gathered in large crowds, are not slow in securing as many as they are able to carry away. By far the greatest number die on the shore, however, and their remains form a true *cordon littoral*, several feet in width

¹ "Deep-Sea Soundings in the Gulf of Mexico and Caribbean Sea" (Chart No. 21 in Report of the U.S. Coast and Geodetic Survey, 1881, Washington, 1883).

² I take the nautical mile, equal to one-sixtieth part of the length of a degree on the great circle of a sphere whose surface is equal to the surface of the earth = 1853·248 m. or 6080·70 feet (J. E. Hilgard, "On the Length of the Nautical Mile," in the Report mentioned in the foregoing note, pp. 354-356).

³ There is in the Museo Nacional of Caracas a tooth of this species, from a specimen which was stranded some years ago on the shores of Margarita. I saw myself, in 1873, another whale, but only for about one minute, in the sea between the islands of Tortuga and Margarita. The animal swam with its mouth wide open and the head partially raised above the surface of the water. The upper jaw was small and narrow, so that it certainly was not a cachalot. Though I could not see the back, I supposed then it might be a Balænoptera, perhaps *B. rostrata*. However, I do not know whether this species comes so far to the south.

and height, which soon fills the air with a most offensive smell.

The latest *ribazon* occurred on the morning of Oct. 10 last. The shoal seems to have come from the north-west, and was extraordinarily large. It contained such species as the "pargo" (*Lutjanus profundus*, Poey, the same as *Mesoprion aya*, Cuv. and Val.), which, as I am informed, had never been observed in any other *ribazon*. The Royal Mail-steamer *Severn*, going eastward at a speed of about eight miles an hour, was for two hours (from seven to nine in the morning) literally cutting through the shoal, and as she struck its main course at an angle of 45° , approximately, the breadth of the shoal must have been ten miles at least.¹ The shoal finally ran on shore to the east of Carúpano, and such was the quantity of stranded fish, especially between the places called Hernan Vazquez and Guayacan, that the local authorities deemed it necessary to summon a large number of workmen, in order to have trenches dug in which to bury the dead fish.

With respect to the causes of these migrations, I think they cannot differ from those which give rise to the well-known migrations of marine fish in other parts, the search for food being no doubt the most important. The waters of the great western Caribbean current are richer in food than the comparatively quiet part of the sea north of the current. The fish travel, therefore, in this direction, and attract of course a gradually increasing number of their enemies. On the coast of Carúpano the fisheries are insignificant, and thus the shoals are not disturbed in their migrations until they reach the shore. Farther to the west, in the waters of Margarita, the case is different, the large fishery establishments of this island having constantly boats and crews in readiness to intercept the shoals, as soon as their arrival is announced by the fire-and-smoke signals of the look-out men stationed on the different headlands and other places known to be favourably situated. With regard to Carúpano, it is certainly a great pity that the fisheries are so neglected that every year a large amount of what ought to be a rich harvest is lost, and left to turn into noxious and fever-breeding carrion.

The *turbios* are *ribazones* during the arrival of which submarine eruptions of deleterious gases, principally sulphuretted hydrogen, happen to break out, so that the fish are killed before they reach the shore, the water at the same time becoming turbid with the mud from the bottom, which is violently stirred up by the outbreak of the gas. The quantity of the latter must be very considerable indeed, as the foul smell on such occasions is noticed all over land and sea.

Gaseous eruptions of the same nature, as well as sulphurous springs, are not at all uncommon in the neighbourhood of Carúpano; the two *azufrales*, about twenty miles to the south of the town, being the most important.² The whole region, in fact, was at the end of the Tertiary period the theatre of a great geological catastrophe, when the Golfo Triste was formed by a sudden subsidence, which was also the origin of the so-called delta of the Orinoco,³ the Gulf of Cariaco, and the many lagoons in the provinces of Cumaná and Maturín. At the same time extensive tracts of land were submerged to the north of the mountains which run through the whole length of the peninsulas of Araya

¹ From information given to me by Señor Bastardo, a medical student at our University, who was a passenger on board the *Severn*.

² Wall and Sawkins, "Report on the Geology of Trinidad," London, 1860, p. 198.

³ The Orinoco has no delta in the true geological sense of this word, as the land comprised between the outer branches of the intricate fluvial plexus of its mouth has not been formed by the river. The southern branch is the old river channel; when the above-mentioned subsidence took place, the land on the left bank sank gradually towards the north, and part of the waters, following the new slope of this northern plane, cut into it the different channels with their connecting branches which, after a slow and tortuous course, empty into the sea between the old mouth of the river and the southern entrance of the Golfo Triste.

and Paria, and thus the Sea of Carúpano was formed. That the South American mainland extended before this catastrophe as far as Grenada, Tobago, and Trinidad, is sufficiently proved by the investigations of Mr. Bland on the land shell fauna of the West Indies, and is more-over corroborated by the comparative shallowness of the sea between the coast of Venezuela and the islands mentioned. Tobago is still within the 100-fathom line, and a rise of the sea-bottom of no more than 400 fathoms would be sufficient to re-establish the terrestrial connection with Grenada.¹

It is self-evident that an immense quantity of organic matter must have been buried with the sunken land. This organic matter contributes to the formation of sulphuretted hydrogen, and is the stratum which feeds the submarine petroleum springs on the coast of Barcelona; whilst in those parts which afterwards were again lifted above the surface of the sea, it appears in the extensive deposits of asphalt known in Trinidad and Maturin, and performs an active part in the generation of the sulphurous vapours of the *azufrales*.

If we consider what a large quantity of fish-remains must gradually accumulate in the shallow waters on the coast of Carúpano, where they are slowly covered by successive layers of finely-sifted sediment, we are enabled to understand how other deposits of a similar character, for instance, that of Monte Bolca, have been formed in bygone ages; indeed, Carúpano will, in time, be another Monte Bolca to the palæontologist of the Coming Race.

Caracas University, October 22

A. ERNST

KILIMA-NJARO²

THE rapid progress of African exploration during the last quarter of a century is strikingly exemplified in the brief history of the monarch of African Mountains. Doubtfully alluded to as the "Ethiopian Mount Olympus" by Enciso in the sixteenth century, and absolutely unknown to science before its discovery by Rebmann in 1848, it has already since that year been several times visited, partly explored, and even ascended to heights of 10,000 and 14,000 feet by Baron von der Decken in 1861-62, by the Rev. Charles New in 1871, and by Mr. Joseph Thomson on his memorable journey "Through Masai Land" in 1883. And the work of these pioneers has now been all but completed by Mr. Johnston, who was early in 1884 specially commissioned by the Royal Society and the British Association to study the interesting fauna and flora of the Kilima-Njaro uplands. During the six months from May to October of that year, passed by him on their southern and eastern slopes, this experienced African traveller has succeeded under great difficulty in collecting abundant materials for illustrating the natural history and physical constitution of the "Mountain of the Snow Fiend," as its euphonious Ki-Swahili name is interpreted. These results are embodied in the work before us, which is alike admirable for its bright and graphic style, and the judicious arrangement of its varied contents. By the simple plan, consistently adhered to throughout, of treating the narrative portion separately, and confining the strictly scientific matter to the concluding chapters, all tastes are consulted, and the common mistake is avoided of sacrificing the interests of the student to those of the general reader.

The few months to which the expedition was limited were passed partly at the station of Kitimbiriu in the Moshi territory ruled over by King Mandara, partly in the more easterly district of Marangu. Both of these tracts are included in the Chaga country, which occupies

all the southern slope, which however, as now appears, does not constitute a single kingdom under Mandara, but comprises a considerable number of petty Bantu States, mostly mutually hostile, and seldom combining except to resist the attacks of the common Masai enemy. Mandara, who had hitherto figured in the history of recent East African exploration as a doughty warrior scarcely second in importance to Mirambo himself, thus sinks to the position of a mere triton amongst the minnows, though still powerful enough to be troublesome, and enjoying a somewhat widespread reputation, if not for personal courage, at least for political sagacity.

As shown in the annexed cut (Fig. 1) the aspect of Kilima-Njaro seen from above Moshi is that of a single snow-capped dome towering to a height of nearly 19,000 feet above the bare or grassy upper slopes, and clothed lower down with a dense and varied tropical vegetation. But when viewed from Lake Jipé, a point lying nearer its base towards the south-east, it appears in its true character of a double-crested snowy mass, in this as in some other respects presenting a remarkable resemblance to the Armenian Ararat. Mr. Johnston, who made two ascents, first from Moshi to a height of 9000 feet, and again from Marangu to about the normal snow-line (16,315 feet, or within a little more than 2000 of the summit), calculated the altitudes of the two peaks, Kibô and Kimawenzi, at 18,800 and 16,250 feet respectively. This only slightly exceeds von der Decken's estimate, who assigns 18,700 feet to Kibô, so that the absolute altitude of the probable culminating point of the continent may be taken at somewhat under 19,000. On the lofty connecting ridge clumps of forest were found still straggling up to 10,000 feet. Many bright-coloured flowers also grew up to this altitude, "notably a vivid blue cynoglossum (houndstongue), mauve and blue irises, and pink, waxy-white, and yellow everlasting. Tufts of artemisia (southernwood) grew in sheltered places. There were many heaths, a small kind of geranium, huge proteas, and divers ferns and mosses" (p. 235). Even at 12,600 feet strange sessile thistles were met, nearly five feet in circumference, besides an extraordinary lobelia (*L. Deckeni*) three to four feet in height, and a very characteristic arborescent plant new to science, and since named *Senecio Johnstoni* (Fig. 2), "looking somewhat like a banana in the distance, but in reality consisting of a tall, black, smooth trunk, 20 to 30 feet in height, and surmounted by a huge crown of broad leaves interspersed or headed up with bunches of yellow blossom. The strange composite grew abundantly in the streamlet's bed, and its trunk was so superficially rooted that, in spite of its height and girth, I could pull it down with one hand" (p. 268).

Beyond 13,000 feet vegetation became stunted and patchy, ceasing altogether about the altitude of 15,000 feet. The last resident bird, a kind of stone-chat (*Finurochroa hypospodia*) was met in flocks, and showing a total absence of fear, up to 13,700 feet, beyond which no bird was seen except a rare high soaring kite, or great-billed raven. Yet such large game as the elephant, buffalo, and antelope are pursued by the natives up to altitudes of 12,000 and 13,000 feet, and captured chiefly by pitfalls. In the Bura district, east of Kilima-Njaro, the *Alcelaphus cokei*, a species of hartebeest, or tall red antelope, was seen associated by a sort of unconscious symbiosis with tall red ant-hills, and deriving some protection from their almost ludicrous resemblance to these objects. "Being a deep red-brown colour, and standing one by one stock-still at the approach of the caravan, it was really most difficult and puzzling sometimes to know which was antelope and which was ant-hill; for the long grass hiding the animal's legs left merely a red-humped mass, which until it moved, might well be the mound of red earth constructed by the white termites. The unconscious mimicry was rendered the

¹ See the chart quoted in the first note.

² "The Kilima-Njaro Expedition, a Record of Scientific Exploration in Eastern Equatorial Africa." By H. H. Johnston, F.Z.S. (London: Kegan Paul, 1886.)